PROCEEDINGS

OF

THE ROYAL SOCIETY.

1840. No. 44.

May 21, 1840.

The MARQUIS of NORTHAMPTON, President, in the Chair.

William Burge, Esq., Walter Ewer, Esq., Thomas Tassell Grant, Esq., and Henry Lawson, Esq., were balloted for, and duly elected into the Society.

The following papers were read, viz.:

1. "Remarks on the Meteorological Observations made at Alten, Finmarken, by Mr. S. H. Thomas in the years 1837, 1838, and 1839." By Major Sabine, R.A., V.P.R.S., and Lieut .Col. Sykes, F.R.S.; being a Report from the Committee of Physics, including Meteorology, to the Council, and communicated by the Council to the Royal Society.

These observations, made at Alten in lat. 69° 58′ 3″ N., and 23° 43′ 10″ east of Paris, would seem to have a claim to the attention of the Royal Society, as they offer the *experimentum crucis* of Professor Forbes's empirical formula respecting the gradual diminution of the daily oscillations of the barometer, within certain limit hours, from the equator to the poles. Professor Forbes has laid down an assumed curve, in which the diurnal oscillation amounts to ·1190 at the equator and 0 in lat. 64° 8′ N., and *beyond that latitude* the tide should occur *with a contrary sign*, plus becoming minus. Now Alten being nearly in lat. 70°, if Professor Forbes's law hold good, the maxima of the diurnal oscillations should occur at the hour for the minima at the equator, and a similar inversion should take place with respect to the minima. Mr. Thomas has himself however modified the value his observations would otherwise have had, by adopting 2 P.M., instead of 3 P.M., for the hour of his observations for the fall; and he has adapted his barometrical observations to a mean temperature of 50° Fahr., instead of 32°. The first year's observations commence on the 1st October, 1837, and terminate on the 30th September, 1838. The barometer stood 66 feet 5 inches above low-water mark, and the thermometer hung at 6 feet above the ground; but care was not always taken to prevent the sun shining on it. The mean height of the barometer for the year was 29°·771, and the mean of the thermometer almost coincident with the freezing point, viz., 32°·017. The

maximum height of the barometer was 30°·89 in January, and the minimum 28°·71 in October. The mean of the barometer at 9 A.M. was 29°·764, therm. 33°·455; at 2 P.M. 29°·765, therm. 33°·327; and at 9 P.M. 29°·784, therm. 29°·270. The diurnal observations would seem to support Professor Forbes's theory; but the 9 P.M. observations are entirely opposed to it, as they appear with the same maximum sign as at the equator, whereas the sign ought to have been the reverse; indeed, with respect to the diurnal observations, the mean of five months of the year at 9 A.M. gives a plus sign, although the mean of the year at 2 P.M. only gives the trifling quantity of ·001 plus. There is one remarkable feature in these observations that cannot fail to strike the meteorologist. M. Arago, from nine years' observations at Paris, reduced to the level of the sea, makes the annual mean height 29°·9546; twenty-one years' observations at Madras make it 29°·958; and three years' observations at Calcutta, by Mr. James Prinsep, make it 29°·764; and Mr. Thomas brings out 29°·771. That there should be this coincidence between the observations at Calcutta and Alten is curious. Neither Mr. Thomas nor Mr. Prinsep state whether or not their means are reduced to the level of the sea. It is to be suspected they are not.

For the next year, that is to say, from Oct. 1838 to Sept. 1839, both inclusive, Mr. Thomas uses a French barometer and French measurements, with centigrade thermometer attached to the barometer, and Fahrenheit's for the detached thermometer. He changes his time of observation from 9 A.M. to 8 A.M., 2 P.M., and 8 P.M., and he reduces his barometrical observations to 0 centigrade. The results of the year are as follow:—mean annual pressure 29°·627 English; thermometer Fahr. 33°·36; greatest pressure in April, least in January!! The mean of 8 A.M. is 29°·620; therm. 33°·75. The mean of 2 P.M. is 29°·631; therm. 34°·73. And at 8 P.M. 29°·631; therm. 30°·57. The diurnal observations assist to support Professor Forbes's theory; but as in the preceding year, the P.M. observation is at fault; and if the hour had been 9 o'clock instead of 8 o'clock, it would probably have been more so than it appears. The low annual mean state of the barometer for the year 1837–38 is even increased in the last year's observations; and as fresh instruments* appear to have been used, there is ground to believe that the fact is associated with the locality, and it may be desirable not only to record in the Proceedings of the Royal Society the data already supplied, but to recommend to Mr. Thomas more particular inquiry on the subject.

The phænomena of the Aurora Borealis appear to have been observed by Mr. Thomas with great assiduity, and recorded with great care. On examining the register, with reference to M. Erman's important remark, that "in Siberia two kinds of aurora are distinguished, one having its centre in the west, and the other in the east, the latter being the more brilliant," it is found that twenty-two

* It appears that the barometer was compared before leaving France, and subsequently to its being taken back to that country.

nights occur in the course of the two winters in which the formation of arches of the aurora is noticed and their direction recorded; of these, *ten* are to the *west*, having their centres rather to the southward of west, the arches extending from N.W. to S.S.E. and S.E.; *seven* are to the *east*, or more precisely to the southward of east, the arches extending from N.E. to S.E. and S.W. Of the five others, *four* are said to be from east to west across the zenith, and cannot therefore be classed with either of the preceding, and *one* is noticed generally as being to the north. The facts here recorded appear to afford an evidence of the same nature as those mentioned by M. Erman, as far as regards there being two centres of the phænomena. In respect to the relative brilliancy of the eastern and western aurora, nothing very decided can be inferred from the register. If, as M. Erman supposes, that they may be referred respectively to "les deux foyers magnétiques de l'hemisphère boréal," it is proper to notice that the position of Alten is nearly midway between those localities.

There can be no doubt that the frequent appearance of the aurora, and the peculiarities of the phænomena observed there, render it a most desirable quarter for a magnetical and meteorological observatory.

EDWARD SABINE.
W. H. SYKES.

2. "Second Letter on the Electrolysis of Secondary Compounds, addressed to Michael Faraday, Esq., D.C.L., F.R.S., &c." By J. Frederic Daniell, Esq., For. Sec. R.S., Professor of Chemistry in King's College, London.

The author, in this letter, prosecutes the inquiry he had commenced in the former one, into the mode in which the chemical elements group themselves together to constitute *radicles*, or proximate principles. He considers his experiments as establishing the principle that, considered as electrolytes, the inorganic oxy-acid salts must be regarded as compounds of metals, or of that extraordinary compound of nitrogen and four equivalents of hydrogen to which Berzelius has given the name of *ammonium*, and compound anions, chlorine, iodine, &c., of the Haloide salts; and as showing that this evidence goes far to establish experimentally the hypothesis originally brought forward by Davy, of the general analogy in the constitution of all salts, whether derived from oxy-acids or hydro-acids. Some remarks are made on the subject of nomenclature, and the rest of the paper is occupied with the details of the experiments, all bearing on the important subject which he has undertaken to investigate.

May 28, 1840.

FRANCIS BAILY, Esq., V.P., in the Chair.

The ballot for the Right Rev. the Lord Bishop of Norwich was deferred until the next meeting of the Society, there not being a sufficient number of Fellows present.

The following papers were read, viz.:

1. "Meteorological Register kept at Port Arthur, Van Diemen's Land, during the year 1838, and Register of Tides at Port Arthur, from August 1838 to July 1839, both inclusive." By Deputy-Assistant-Commissary-General Lempriere. Communicated by Sir John Franklin, R.N., F.R.S., &c.

2. "Notice relative to the form of the Blood-particles of the *Ornithorhynchus hystrix*." By John Davy, M.D., F.R.S.

A portion of the blood of the *Ornithorhynchus hystrix*, mixed when fresh with a strong solution of common salt, being examined by the author, exhibited a few globules of irregular shape. Another portion, preserved in syrup, contained numerous globules, most of which had an irregular form, but many were circular; none, however, were elliptical, like those of birds. Hence the author concludes, that in form they accord more with those of Mammalia.

3. "Researches on Electro-chemical equivalents, and on a supposed discrepancy between some of them and the atomic weight of the same bodies, as deduced from the theory of isomorphism." By Lieut.-Colonel P. Yorke. Communicated by Michael Faraday, Esq., D.C.L., F.R.S., &c.

The author describes various experiments made with a view to determine the electro-chemical equivalents of sodium and potassium. Three experiments gave, respectively, 22·3, 22·9, and 25, as the equivalent of the former; and two other experiments gave, respectively, 45 and 41·7, as the equivalent of the latter of these substances. He then inquires what would be the result of the electrolyzation of the aqueous solutions of soda and potash, on the hypothesis of these bodies being composed of two equivalents, or atoms, of metal, and one of oxygen. To determine this question he employs a solution of dichloride of copper in muriatic acid, as being a substance composed of two atoms of metal and one of an electronegative element. Its electrolysis gave as the equivalent of copper, 52·8, 59·4, and 61·6, numbers approximating closely to 63·2, or double the atomic weight of copper. After a long train of investigation, he concludes that there is no reason deducible from the theory of isomorphism for doubting the correctness of the received atomic weights of silver, sodium, &c., but that the difficulty, or anomaly, if it may be so called, should be considered as attaching itself to the di-compounds of copper; and that Faraday's propositions on this subject remain unimpeached.

4. "Second series of Approximate Deductions made from about 50,000 observations taken during the years 1836, 1837, and 1838, at the P. Louis Observatory, Mauritius, four times each day; namely, at 8 A.M., at noon, and at 4 and 8 P.M." By J. A. Lloyd, Esq., F.R.S.

5. "On the Solubility of Silica by Steam; with an account of an experiment on the subject, conducted in the East Indies by

Julius Jeffreys, late of the Hon. East India Company's Medical Establishment."

The inner surfaces of a flue built of siliceous bricks appeared to be deeply eroded by the passage over it of steam at a very high temperature, and fragments of siliceous materials laid in the course of the current were partially consumed. A siliceous crust was deposited on several vessels of stone ware, coated with a micaceous glaze, placed in the upper part of the furnace, and this crust was re-dissolved when the vessels were removed to a hotter situation in the same furnace. The author notices the experiments of Dr. Turner and others, which failed in showing the solubility of silica by steam, in consequence, as he conceives, of the heat having not been sufficiently great to effect the solution.

June 4, 1840.

The MARQUIS of NORTHAMPTON, President, in the Chair.

Justus Liebig, Johannes Müller, and Jacques Charles François Sturm, were severally elected Foreign Members of the Society.

The Right Rev. the Lord Bishop of Norwich, Lieut. Thomas Cook, R.N., and William Hutton, Esq., were balloted for, and duly elected into the Society.

A paper was read, entitled, "Contributions to the Chemical History of Archil and of Litmus." By Robert Kane, M.D., M.R.I.A. Communicated by Francis Baily, Esq., V.P.R.S.

After a preliminary sketch of the labours of Heeren and of Robiquet in investigating the origin of the beautiful colouring materials termed *Archil* and *Litmus*, obtained from different kinds of colourless lichens, and their detection of the two proximate principles termed *erythrine* and *orceine*, the author states the object of the inquiries detailed in the present paper to be threefold; viz. first, to ascertain the primitive form of the colour-making substance in a given species of lichen, and trace the stages through which it passes before the coloured substance is developed; secondly, to determine the nature of the various colouring substances which exist in the archil of commerce; and thirdly, to examine the colouring materials of ordinary litmus. He finds in the lichen *Roccella tinctoria* the following bodies, either pre-existing in the plant, or formed during the processes employed for its analysis: 1. Erythryline; 2. Erythrine (the Pseudo-erythrine of Heeren); 3. Erythrine bitter; 4. Telerythrine; and 5. Roccelline (the Roccellic acid of Heeren). The properties and constitution of these substances are then described, and the chemical formulæ given, which are deducible from their respective analyses. The author finds the archil of commerce to consist essentially of three ingredients, namely, orceine, erythroleic acid, and azoerythrine; of each of the two former there exist two modifications,

and there is, in addition, a yellow matter. After comparing his results with those obtained by Heeren, by an examination of the products evolved by his erythrine in contact with air and with ammonia, and stating reasons for some changes in nomenclature, the author gives the chemical formulæ resulting from his own analysis of these different substances.

His inquiries into the constitution of ordinary litmus, which form the last division of his subject, lead him to the conclusion that that substance contains the principles designated by him as Erythrolein, Erythrolitmine, Azolitmine, and Spaniolitmine; and that the colouring constituents of litmus are, in their natural condition, red; the blue substances being produced by combination with a base, which bases in that of commerce are lime, potass, and ammonia; and there is mixed up in the mass a considerable quantity of chalk and sand. The details of the analyses of these several substances, and the resulting chemical formulæ representing their constitution, are then given.

The concluding section of the paper is occupied by an inquiry into the decoloration of the bodies which exist in archil and in litmus. The latter of these, the author concludes, is reddened by acids, in consequence of their removing the loosely combined ammonia by which the blue colour is produced; and the so-called hydrogen acids liberate the colouring matter by their combining with the alkali to form bodies (either chlorides or iodides), with which the colouring matter has no tendency to unite. Hence it appears that the reddening of litmus is no proof that chloride of hydrogen is an acid, and that the double decomposition which occurs is the same in principle, whether hydrogen or a fixed metal come into play. After detailing the blanching effects of other deoxydizing agents on the colouring matter of litmus, and the action of chlorine on orceine and azolitmine, the author remarks, that in these actions chlorine is subjected to conditions different from those which determine the nature of the results with the generality of organic bodies, and that the displacement of hydrogen, so marked in other cases, does not exist in the class of substances under consideration; but that, in reality, the products of the bleaching energy of chlorine resemble in constitution the compounds of chlorine which possess bleaching powers.

A paper was also read, entitled, "On the Corpuscles of the Blood." By Martin Barry, M.D., F.R.S.

The author in the course of his researches in Embryology, detailed in his "third series," observed that some of the corpuscles of the blood undergo progressive alterations in their structure. The corpuscles so altered he believes to be of the same kind as those described by Professor Owen; and having found that the alterations in question terminate in a separation of the corpuscles into globules, he thinks this fact confirms the idea of Professor Owen—that the blood-disc undergoes spontaneous subdivision. The author farther observed that the corpuscles of the blood, in certain altered states, undergo rapid and incessant changes of form, which cannot be traced

to the action of neighbouring cilia. A corpuscle will sometimes assume the figure of an hour-glass, as if it were preparing to divide itself into two parts, but it instantaneously either regains its previous form, or assumes a new one. These motions are incessant, and so rapid that it is not easy to catch and delineate any of the resulting forms; they are compared to the writhings of an animal in pain. The author has seen them in a rabbit, as late as two hours and a half after death, and thinks it probable that they may continue for a longer time, although, when under the microscope, they gradually and in a short time cease; the rapid changes of form, which are at first apparent, passing into gentle undulations, and being succeeded by an alternation of rest and motion.

Should these facts be thought to confirm the opinion of John Hunter, that the blood "has life within itself," or "acquires it in the act of forming organic bodies," because its corpuscles in certain states exhibit "vital actions," still his assertion that "the red globules" are the least important part of the blood, will appear to have no just foundation.

The author finds that the phenomena attending what is called "vital turgescence" of the blood-vessels, depend not merely on an accumulation and stagnation of blood, but on changes in the condition of its corpuscles, which assume a more or less globular, or elliptical appearance resembling cells. Their interior is dark, from a great increase of red colouring matter which accumulates around a pellucid and colourless point, corresponding in situation to that of the central part of nuclei in other cases; and so completely do the corpuscles fill their vessels, that the fluid portion of the blood is excluded, and the corpuscles are compressed into polyhedral forms. This condition of the blood-corpuscles during vital turgescence of the vessels, the author thinks deserving of consideration, in connexion with many of the phenomena attending local accumulations of blood, both in health and in disease; and more especially with reference to increased pulsation, the exudation of colourless fluid, and the heat and redness of inflamed parts.

According to the views of the author, the formation and nourishment of organs is not effected merely by the fluid portion of the blood, for he has discovered that the cells which he showed in his "Third Series of Researches in Embryology" form the chorion, are altered blood-corpuscles; and he has farther found that muscular fibre (that is, the future muscle-cylinder, not the fibril) is formed by the coalescence of cells, which also are derived from corpuscles of the blood. He has seen and figured every stage of transition, from the unaltered blood-corpuscle to the branched cells forming the chorion, on the one hand, and to the elliptical or oblong muscle-cells, on the other. The colour is not changed, except that the blood-corpuscles, when passing into cells for the formation of muscle, become of a much deeper red. There seems to occur in these an increase of red colouring matter.

Valentin, in describing the mode of the formation of muscle, had stated that globules approach one another and coalesce to form

threads, which in many places have the appearance of a necklace, but subsequently lose the traces of division, and become cylinders. Schwann had conjectured that the globules just referred to—as having been observed by Valentin—are cells, and that these cells coalesce to form a secondary cell, that is, the muscle-cylinder. The author confirms the observations of Valentin and the conjectures of Schwann, with the addition, that the globules coalescing to form the muscle-cylinder are blood-corpuscles which have become cells. The fibrils appear to be subsequently formed within the cylinder, which thus becomes the muscular fasciculus. The medullary portion of the cylinder appears to be composed of the pellucid objects, one of which is contained within each altered blood-corpuscle. Some of these pellucid objects, however, continue to occupy a peripheral situation.

The author thinks it is not probable that muscular fibre and the chorion are the only tissues formed by the corpuscles of the blood; he is disposed rather to inquire, how many are the tissues which they do not form? Nerves, for instance, are known to arise very much in the same manner as muscle-cylinders; and epithelium-cells sometimes present appearances which have almost suggested to the author the idea that they were altered corpuscles of the blood.

Schwann had prevously shown that "for all the elementary parts of organisms there is a common principle of developement,"—the elementary parts of tissues having a like origin in cells, however different the functions of those tissues. The facts made known in the present memoir not only afford evidence of the justness of the views of Schwann, but they farther show that objects, such as the corpuscles of the blood, having all the same appearance, enter immediately into the formation of tissues which physiologically are extremely different. Some of these corpuscles arrange themselves into muscle, and others become metamorphosed into constituent parts of the chorion. But the author thinks it is not more difficult to conceive corpuscles having the same colour, form, and general appearance, undergoing transformations for very different purposes, than to admit the fact made known by two of his preceding memoirs,—namely, that the nucleus of a cell, having a central situation in the group which constitutes the germ, is developed into the whole embryo, while the nuclei of cells occupying less central situations in the group, form no more than a minute portion of the amnion. It is known that in the bee-hive a grub is taken—for a special purpose—from among those born as workers, which it perfectly resembles until nourished with peculiar food, when its developement takes a different course from that of every other individual in the hive.

The Society then adjourned over the Whitsun Recess, to meet again on the 18th instant.

June 18, 1840.

The MARQUIS of NORTHAMPTON, President, in the Chair.

Jean Baptiste Dumas, was elected a Foreign Member of the Society.

Lieutenant-Colonel John George Bonner, E.I.C.S., and John Narrien, Esq., were balloted for, and duly elected into the Society.

The President informed the Meeting that the Council had voted the following Addresses of Congratulation to Her Majesty the Queen, and His Royal Highness Prince Albert, on the occasion of the late traitorous attack made upon their lives.

"*To the Queen's Most Excellent Majesty.*

"The humble Address of the President, Council, and Fellows of the Royal Society of London for improving Natural Knowledge.

"Most Gracious Sovereign,

"We, Your Majesty's subjects, the President, Council, and Fellows of the Royal Society of London for improving Natural Knowledge, deeply penetrated with feelings of indignation and abhorrence at the treasonable and atrocious attack lately made on Your Majesty's sacred person, beg leave to approach your Throne, and to offer our heartfelt congratulations on Your Majesty's providential escape from the wicked designs of an assassin.

"We lift up our hearts in joyful thankfulness to the Almighty Disposer of Events for his merciful protection of a life so dear to all Your Majesty's subjects, and so important to the welfare and prosperity of these realms; and we most earnestly pray that the same Providence, so signally manifested on the late event, may continue to shield Your Majesty from every danger; and that during a long, prosperous and happy reign, Your Majesty may live in the enjoyment of the affection and prayers of a grateful and united people."

"*To His Royal Highness Prince Albert of Saxe-Coburg and Gotha.*

"The humble Address of the President, Council, and Fellows of the Royal Society of London for improving Natural Knowledge.

"May it please Your Royal Highness,

"We, the President, Council, and Fellows of the Royal Society of London for improving Natural Knowledge, approach your Royal Highness with the expression of our heartfelt gratitude to the Almighty Disposer of Events for the protection of Her Majesty and Your Royal Highness from the traitorous attack of an assassin, and to offer our sincere congratulations for the safety of a life so important to the welfare of this great empire, as well as to the happiness of our beloved Sovereign.

"In offering these our sentiments, we cannot forget that Your Royal Highness, by becoming one of our members, has proclaimed to the world Your Royal Highness's attachment to those sciences

for the advancement of which our Society was established, and which tend at the same time to the glory of the nation that protects them, and to the happiness of the whole civilized world."

These Addresses were unanimously adopted by the Society.

The following letter was read from G. G. Anson, Esq., addressed to the President, enclosing a specimen of a deposit with which nine acres of land near Exeter, belonging to Lord Radnor, had been covered after the subsidence of a flood, and which was sent by H.R.H. Prince Albert, F.R.S. :—

"*Buckingham Palace, June* 8, 1840.

"My dear Lord,

"His Royal Highness Prince Albert has commanded me to forward to you the enclosed specimen, which has been sent up to His Royal Highness from Lord Radnor's place near Exeter, where nine acres of land were covered with this curious substance after a flood had subsided. His Royal Highness thinks it very probable that the subject may already have been brought before the Royal Society, but in case it should not have been, he sends the accompanying packet. It is said that a good deal of it has been applied to the purpose of making waistcoats for poor people.

"Believe me,

"My dear Lord,

"Yours very faithfully,

"G. G. Anson.

"*The Marquis of Northampton, President of the Royal Society.*"

The following description of the specimen referred to in the letter, drawn up by John Lindley, Ph. D. F.R.S., was also read:

"Description of the Specimen referred to in the preceding letter." By John Lindley, Ph. D., F.R.S.

The plant which overran Lord Radnor's land is the *Conferva crispa* of Dillwyn, which is said to be the *Conferva fluviatilis* of Linnæus. The species inhabits fresh water, and multiplies with great rapidity, forming entangled strata. The green portion is the Conferva in its young state, the white portion is the plant old and bleached. The whole mass consists of articulated filaments, among which are fragments of grass-leaves.

The following papers were then read, or their titles announced :—

1. An Account of Experiments on the Reflecting Telescope. By the Right Hon. Lord Oxmantown, F.R.S.

This paper enters minutely into the details of the experiments, of the precautions requisite to ensure success, and of the manipulations ultimately adopted in forming a speculum three feet in diameter, subsequently applied to a telescope, mounted in a manner very similar to that of Sir John Herschel. The author states, as the results he arrived at, that specula can be made to act effectively, when cast of the finest speculum metal, in separate portions, and retained in

their positions by an alloy of zinc and copper, as easily wrought as common brass, and that they can be executed in this manner of any required size; that castings of the finest speculum metal can be executed of large dimensions, perfect, and not very liable to break; that machinery can be employed with the greatest advantage in grinding and polishing specula; that to obtain the finest polish, it is not necessary that the speculum should become warm, and that any temperature may be fixed upon, and preserved uniform during the whole process; and that large specula can be polished as accurately as small ones, and be supported so as to be secured from flexure.

2. On the theoretical explanation of an apparently new Polarity in Light. By G. B. Airy, Esq., M.A., F.R.S., Astronomer Royal.

The existence of a polarity in the rays of homogeneous light, having regard only to the sequence of colours in the spectrum, was inferred by Sir David Brewster from some experiments, of which he has given an account, contained in the Report of the seventh meeting of the British Association. The author states the results of his own observations of similar phenomena, and their theoretical explanation on the undulatory theory, together with the mathematical development of that explanation.

3. On the Ferrosesquicyanuret of Potassium. By Alfred Smee, Esq. Communicated by P. M. Roget, M.D., Sec. R.S.

The author examines, in this paper, the action of chlorine upon the ferrocyanate of potassa, and the conversion of the latter into ferrosesquicyanuret; and proposes methods for obtaining this latter salt uncontaminated with impurities, and free from the difficulties and inconvenience attendant on the present mode of preparation.

4. On the influence of Iodine in rendering several argentine compounds, spread on paper, sensitive to light; and on a new Method of producing, with greater distinctness, the Photogenic Image. By Mr. Robert Hunt. Communicated by Sir John Herschel, Bart., V.P.R.S.

This paper contains various details of the results of a great number of experiments made with a view of rendering paper capable of being employed instead of metallic plates, in Daguerre's photographic process. It is accompanied with 12 papers as specimens.

5. Hourly Observations of the Barometer and Thermometer at sea, on the 21st of March, 1840. By Major-General A. Lindsay, H.E.I.C.S. Communicated by Sir John F. W. Herschel, Bart., V.P.R.S.

These observations were made on board the ship Owen Glendower, on her voyage from Calcutta to London.

6. On the Constitution of Pigotite, and on the Mudesous and Mudesic Acids. By James F. W. Johnston, Esq., M.A., F.R.S.

In this paper the author describes a substance, found by himself

and by the Rev. M. Pigot, forming an incrustation on the sides of certain caves, occurring in the granitic cliffs on the east and west coast of Cornwall. This incrustation is in mass of a brown, and in powder of a yellow colour; is insoluble in water and alcohol; when heated, it gives off much water, blackens, yields empyreumatic products, and leaves a black mass, having occasionally the lustre of graphite. In the air, at a bright red heat, this mass very slowly burns, leaving a grey or white ash, which consists of alumina, with some slight foreign admixtures.

The organic constituent of this substance (pigotite), the author considers to be derived from the decay of the various plants which grow on the moist moorlands above, and which, being carried by the waters into the fissures of the granite beneath, combines with the alumina of the decomposed felspar; and when it reaches the air, deposits itself on the roof and sides of the caverns, in the form of layers, varying from a line to two or three inches in thickness. With reference to its supposed origin, the author has given to the organic constituent the name of *mudesous* acid (from *μυδησις*, signifying decay through excess of moisture), and he mentions an observation, communicated to him by Dr. Bouse, that the roots of the sea pink (*Statice armeria*) contain a colouring matter resembling, *in appearance*, the solutions of the mudesous acid.

From numerous experiments and analyses detailed at length in his paper, the author derives the following general results:

1. That the native pigotite contains a dark-brown soluble, not deliquescent acid of vegetable origin, which, in the anhydrous state, is represented by $C_{12}\,H_5\,O_8$.

2. That this acid, the *mudesous*, is tribasic, the salt of silver (mudesite), being represented by $(3\,A_g\,O + C_{12}\,H_5\,O_8)$, and precipitates the salts of the metallic oxides of a brown colour.

3. That the native mudesite of alumina (Pigotite) is represented as follows:

a. Dried in the air by $(4\,\underline{\dddot{A}l} + C_{12}\,H_5\,O_8 + 27\,H\,O)$.

b. Dried at 212° F. by $(4\,\underline{\dddot{A}l} + C_{12}\,H_5\,O_8 + 8\,H\,O)$, losing 27 per cent. of water.

c. Dried at 300° F. by $(4\,\underline{\dddot{A}l} + C_{12}\,H_5\,O_8 + 8\,H\,O)$, losing 32 per cent. of water.

4. That this native mudesite, however, is more probably a compound of the organic tribasic salt, with a hydrate of alumina, and may be rationally represented thus:

a. Dried in the air by $(\underline{\dddot{A}l} + C_{12}\,H_5\,O_8 + {}_9HO) + 3\,(\underline{\dddot{A}l} + 6HO)$.

b. Dried at 212° F. by $(\underline{\dddot{A}l} + C_{12}\,H_5\,O_8 + 4HO) + 3\,(\underline{\dddot{A}l} + 2HO)$.

c. Dried at 300° F. by $(\underline{\dddot{A}l} + C_{12}\,H_5\,O_8 + 2HO) + 3\,(\underline{\dddot{A}l} + 2HO)$.

5. That when treated with nitric acid, the native mudesite, as

well as the mudesous acid itself, are oxidized and converted into a new brownish-yellow, soluble and deliquescent acid, containing more oxygen, and in the anhydrous state represented by $C_{12} H_5 O_{10}$.

6. That this new acid, the *mudesic*, combines readily with alumina and protoxide of mercury, giving salts of a yellow colour. Both the acids described in this paper are distinguished for their tendency to precipitate alumina and the protoxide of mercury. The mudesate of mercury dried at 300° F., is represented by $(2 H_9 O + C_{12} H_5 O_{10})$.

7. That chlorine, when made to act on either of the acids, or their salts of alumina in contact with water, gradually deprives them of all colour, while, at the same time, muriatic acid is formed. Collected on the filter, boiled in water till the washings cease to precipitate nitrate of silver, and dried, the white gelatinous, apparently altered mudesite or mudesate, is found on analysis to contain no atomic proportion of chlorine, but to have sensibly the constitution of the mudesic acid, or mudesates prepared by the direct action of nitric acid. The author thinks it not unlikely that a chloro-mudesic acid exists, and may be formed during this process, represented probably by $C_{12} H_4 Cl O_{10}$, but which he has not succeeded in obtaining in a separate state.

The mudesous and mudesic acids are distinguished from each other by giving, the former brown, and the latter yellow precipitates with the neutral metallic salts—by being the former unaltered, and the latter deliquescent in the air. Both form deliquescent salts with ammonia, and appear to undergo alteration by the long-continued action of hydrosulphuric, or of concentrated sulphuric and hydrofluoric acids.

7. On the Constitution of the Resins, Part V. By James F. W. Johnston, Esq., M.A., F.R.S.

In this paper the author continues his examination of what are called the fetid resins, and from repeated analyses deduces for the resin of Sagapenum the formula $C_{40} H_{29} O_9$, and for that of Galbanum $C_{40} H_{27} O_7$. He then compares the formulæ for the four resins:

Opoponax $= C_{40} H_{25} O_{14}$, Assafœtida $= C_{40} H_{26} O_{10}$,
Galbanum $= C_{40} H_{27} O_{70}$, Sagapenum $= C_{40} H_{29} O_9$;

and considers it probable that, though no striking analogy among the *irrational* formulæ for these resins is perceptible, by which their analogy in physical properties can be accounted for, that they may possess an analogous *rational* constitution, which future researches may disclose.

Euphorbium consists of two resins, of which the more soluble, A, gave the formula $C_{40} H_{31} O_6$. Elemi also consists of two resins, of which the more soluble, A, is represented by $C_{40} H_{32} O_4$, and the less soluble, B, by $C_{40} H_{32} O_1$, as had previously been shown by Hess and Rose. The Bdellium of commerce contains much gum, and a resin $C_{40} H_{31} O_5$.

The resin of Benzoin presented peculiar difficulties when submitted to investigation, from the ease with which it undergoes de-

composition, even at temperatures much below that at which it melts. With regard to this resin, the author gives the following as the result of his numerous analyses:—

1. That the colourless resin of benzoin is represented approximately by $C_{40} H_{22} O_9$.

2. That by heat and dilute carbonated alkalies it is decomposed into water, benzoic acid, a little volatile oil, and a resin $C_{40} H_{23} O_9$, or $C_{40} H_{24} O_9$.

3. That by boiling with quicklime, or concentrated carbonated alkalies, it gives two resins, one in large quantity $= C_{40} H_{24} O_8$; and another in small quantity $= C_{40} H_{30} O_7$.

4. That by caustic potash the crude resin is resolved into two resins represented respectively by $C_{40} H_{22} O_9$, and $C_{40} H_{30} O_7$, of which the former is precipitated, and the latter remains in solution, when a saturated aqueous solution of caustic potash is added to an alcoholic solution of the crude resin.

5. And that by oxide of lead two resins are separated, for which analysis gave respectively the formulæ $C_{40} H_{22} O_9$ and $C_{40} H_{26} O_{10}$.

The author concludes by stating that such metamorphoses are by no means confined to this resin, though the more accurate knowledge of their nature, obtained by the imperfect study he has made of the resin of benzoin, has explained many anomalies he had previously observed, with regard to the relations of the resins to the alkalies and metallic oxides. He considers the group of which dragon's blood is the type, and which he represents by the expression $C_{40} H_{24} \pm x O_9$ to be peculiarly susceptible of modification (or decomposition?) by the action of bases; and he specifies among other results, with regard to which it is his intention to address the Society in a future paper, that dragon's blood, of which the lump variety $= C_{40} H_{21} O_8$, and the drop variety (heated to 300° F.) $= C_{40} H_{20} O_8$, gives by the action of quicklime and oxide of lead, among other products, two resins represented approximately by $C_{40} H_{20} O_{10}$ and $C_{40} H_{20} O_{12}$?—that guiacum $= C_{40} H_{23} O_{10}$, with oxide of lead, gives a resin $= C_{40} H_{21} O_{11}$, the resin of jalap $= C_{40} H_{34} O_{18}$; by the action of the same oxide, a resin $= C_{40} H_{34} O_{20}$, and that of assafœtida $= C_{40} H_{26} O_{10}$, a new resin $= C_{40} H_{23} O_{13}$. These metamorphoses lead to the second great branch of inquiry respecting the nature and constitution of the resins. Certain results being established, at least approximately, with regard to the *irrational* constitution of the resins, and certain general irrational formulæ by which to express it, we are prepared for the study of their *rational* constitution. This part of the subject the author proposes to consider farther in subsequent communications.

8. Researches on the Tides. Twelfth Series. On the Laws of the Rise and Fall of the Sea's surface during each tide. By the Rev. W. Whewell, B.D., F.R.S., Fellow of Trinity College, Cambridge.

The materials of the present investigation are five months' tide observations made at Plymouth; three months observations made

at Liverpool, under the direction of Captain Denham, R.N.; and twelve months' observations made at Bristol, by Mr. Bunt, by means of his tide-gauge. According to the theory of the tides, the height of the surface of the water at a given place will increase as the sine, while the time increases as the arc. Hence if the time be made the abscissa, and the height the ordinate, the curve representing one tide would be the *figure of signs*. The author on making the comparison of the empirical curve of the rise and fall of the water, deduced from observation, with this theoretical curve, finds a general agreement between them; subject to certain deviations, consisting principally in the empirical curve indicating that both the rise and the fall are not symmetrical, like the theoretical curve, in consequence of the fall being generally more rapid than the rise, and thus occasioning a displacement of the summit of the curve towards that branch of it which corresponds to the fall.

9. Researches in Embryology. Third Series.—Additional Observations. By Martin Barry, M.D., F.R.S.

Having in the paper to which the present is supplementary made known the fact that the germinal spot in the mammiferous ovum resolves itself into cells, with which the germinal vesicle becomes filled, the author has since directed his attention to the corresponding parts in the ova of birds, batrachian reptiles, and osseous fishes, which he finds to be the seat of precisely the same changes. The numerous spots in the germinal vesicle of batrachian reptiles and osseous fishes are no other than the nuclei of cells. The cells themselves, from their transparency, are at first not easily discerned, and appear to have hitherto escaped notice; but after the observer has become aware of their presence, they are, in many instances, seen to be arranged in the same manner, and to present the same interior themselves as the corresponding cells in the ovum of mammalia.

In the representations given by Professor Rudolph Wagner, the discoverer of the germinal spot, the author recognizes evidence of the same changes in ova throughout the animal kingdom. He confirms and explains the observations of R. Wagner, that in the ova of certain animals an originally single spot divides into many, and that in the ova of other animals the number of spots increases as the ovum ripens. But he expresses also the opinion that in all ova there is originally but a single spot, this being the nucleus of the germinal vesicle or cell.

The analogy between the ova of mammalia and the animal abovementioned, extends also to the substance surrounding the germinal vesicle, which consists of nucleated cells.

10. Description of a Calculating Machine invented by Mr. Thomas Fowler, of Torrington in Devonshire. By Augustus De Morgan, Esq. Communicated by F. Baily, Esq., V.P.R.S.

The arithmetical operations performed by the machine are those of multiplication and division; the factors and product in the former case, and the quotient, dividend and divisor in the latter, being

expressed in digits of the ternary scale of notation, every digit being either $-1, 0$, or $+1$. In this system, unity being, in multiplication, only an index, the rules for multiplication and division must consist entirely in directions for the management of the signs of unity; and it is on this principle that Mr. Fowler's machine is made to act. A short account is given of the principal parts of the machine, and of the mode in which they bring out the final results. It is necessary, however, in applying it to use, to have recourse to tables, both for converting the factors and reconverting the result; operations which introduce both labour and risk of error.

11. On the Minute Structure and Movements of Voluntary Muscles, in a letter addressed to R. B. Todd, M.D., F.R.S., &c. By William Bowman, Esq., Demonstrator of Anatomy in King's College, London, and Assistant Surgeon to King's College Hospital. Communicated by Dr. Todd.

The objects of the author, in this paper, are the following.—1st. To confirm, under some modifications, the view taken of the primitive fasciculi of voluntary muscles being composed of a solid bundle of fibrillæ. 2dly. To describe new parts entering into their composition: and 3dly. To detail new observations on the mechanism of voluntary motion.

He first shows that the primitive fasciculi are not cylindrical, but polygonal threads; their sides being more or less flattened where they are in contact with one another; he next records, in a tabular form, the results of his examination of their size in the different divisions of the animal kingdom. It appears that the largest are met with in fish; they are smaller in reptiles, and their size continues to diminish in insects, in mammalia, and lastly, in birds, where they are the smallest of all. In all these instances, however, an extensive range of size is observable, not only in different species, but in the same animal, and even in the same muscle. He then shows that all the fibrillæ into which a primitive fasciculus may be split, are marked by alternate dark and light points, and that fibrillæ of this description exist throughout the whole thickness of the fasciculus; that the apposition of the segments of contiguous fibrillæ, so marked, must form transverse striæ, and that such transverse striæ do in fact exist throughout the whole interior of the fasciculus. He next inquires into the form of the segments composing the fibrillæ, and shows that their longitudinal adhesion constitutes *fibrillæ*, and their lateral adhesion *discs*, or plates, transverse to the length of the fasciculus; each disc being, therefore, composed of a single segment from every one of the fibrillæ. He shows that these discs always exist quite as unequivocally as the fibrillæ, and gives several examples and figures of a natural cleavage of the fasciculus into such discs. It follows that the transverse striæ are the edges, or focal sections of these discs. Several varieties in the striæ are then detailed, and the fact noticed that in all animals there is frequently more or less diversity in the number of striæ in a given space, not only on contiguous fasciculi, but also on the same fasciculus at different parts.

The author then proceeds to describe a tubular membranaceous sheath, of the most exquisite delicacy and transparency, investing each fasciculus from end to end, and isolating it from all other parts; this sheath he terms *Sarcolemma*. Its existence and properties are shown by several modes of demonstration; and among others, by a specimen in which it is seen filled with parasitic worms (Trichinæ), which have removed all the fibrillæ. The adhesion of this sarcolemma to the outermost fibrillæ is explained.

It is also shown that there exist in all voluntary muscles a number of minute *corpuscles* of definite form, which appear to be identical with, or at least analogous to the nuclei of the cells from which the development of the fasciculi has originally proceeded. These are shown to be analogous to similar bodies in the muscles of organic life, and in other organic structures.

The author next describes his observations on the mode of union between tendon and muscle; that is, on the extremities of the primitive fasciculi. He shows that in fish and insects the tendinous fibrillæ become sometimes directly continuous with the extremities of the fasciculi, which are not taper, but have a perfect terminal disc. In other cases the extremities are shown to be obliquely truncated, where the fasciculi are attached to surfaces not at right angles to their direction.

Lastly. He states his opinion, and gives new facts on which it is founded, that in muscular contraction the discs of the fasciculi become approximated, flattened, and expanded; the fasciculi, of course, at the same time becoming shorter and thicker. He considers that in all contractions these phenomena occur; and he adduces arguments to show the improbability of the existence of any rugæ or zigzags as a condition of contracting fasciculi in the living body. The paper is abundantly illustrated by drawings of microscopic appearances.

The Society then adjourned over the long vacation, to meet again on the 19th of November next.